
CHROMOSOME REPORTS FROM SOUTH AMERICAN *HYPOCHAERIS* (ASTERACEAE)¹

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ABSTRACT

Eighty-nine new chromosome counts are reported from 85 populations of 15 species of *Hypochaeris* (Asteraceae, Lactuceae) from South America, including first reports from nine taxa (*H. apargioides*, *H. clarionoides*, *H. palustris*, *H. scorzonerae*, *H. setosa*, *H. sonchoides*, *H. spathulata*, *H. tenuifolia*, *H. thrincioides*). Most are $2n = 8$ with bimodal and asymmetric karyotypes. Tetraploidy ($2n = 16$) is documented for the first time in some populations of *H. meyeniana*, *H. scorzonerae*, and *H. tenuifolia*. A summary of previous and new counts reveals that only two uniformly tetraploid species are known (*H. incana* and *H. stenocephala*). Five taxa also show infraspecific polyploidy: *H. chondrilloides*, *H. meyeniana*, *H. scorzonerae*, *H. sessiliflora*, and *H. tenuifolia*. Polyploidy, therefore, occurs in about 10% of the South American taxa. The South American representatives of the genus are all based on $x = 4$ in contrast to more conspicuous karyotypic differences among European taxa ($2n = 6, 8, 10, 12$). This pattern of greater cytological uniformity among many species of the New World (ca. 50 known, 32 now counted chromosomally) suggests that the group was derived from European ancestors rather than the reverse. It appears that *Hypochaeris* in South America radiated explosively into many habitats from sea level to over 3000 m, but that this radiation has not often been accompanied by conspicuous chromosomal change. The absence of aneuploidy and relatively low frequency of polyploidy, plus few known cases of present interspecific hybridization, suggest a weakened role for hybridization as an evolutionary mechanism in the group. Data so far suggest diploid recombinational speciation as the dominant mode accompanied by genetic rather than dramatic cytological alterations, plus occasional polyploid derivatives.

Key words: Asteraceae, chromosome numbers, *Hypochaeris*, karyotype, South America, speciation.

Although much is known about mechanisms of speciation and species-level biogeography in the floras of Europe and North America (e.g., Stebbins, 1971; Stebbins et al., 1953; Grant, 1981), little is understood about these same processes in the flora of South America. To help reveal these dynamics in the temperate regions of southern South America, we have begun a series of investigations on *Hypochaeris* L. (Asteraceae, Lactuceae; *Hypochaeris* L., orthogr. var.). This is a genus of approximately 60 species, with 9 in Europe (DeFillips, 1976) and ca. 50 confined to South America, many of which are localized in the Southern Cone (Bortiri, 1999). *Hypochaeris* is a good genus to extract information on modes of speciation and patterns of biogeography because of the large size and small number of chromosomes (Stebbins, 1971), the diverse morphologies of the taxa varying from small acaulescent alpine forms to broad-leaved large-headed species, and distributions in very different ecological zones ranging from sea level to over 3000 m (Lack, 1979). Apparent rapid and recent speciation

of the genus in South America, therefore, combined with favorable karyological aspects, offers a useful system in which to examine evolutionary processes.

Chromosome counts as well as detailed karyological studies have been investigated for European species of *Hypochaeris* (Parker, 1976; Mugnier & Siljak-Yakovlev, 1987; Barghi et al., 1989; Siljak-Yakovlev et al., 1994; Cerbah et al., 1995, 1998a), which appear to possess symmetrical karyotypes, and which show general correlations of different chromosome numbers ($2n = 6, 8, 10, 12$) with taxonomic sections. Molecular phylogenetic studies using ITS regions among these European taxa (Cerbah et al., 1998b), and including four species from South America, have also revealed useful insights on broad evolutionary patterns within the genus that correlate, to some considerable degree, with previous sectional limits.

Despite the large number of species of *Hypochaeris* from South America, they have been poorly studied karyologically. Chromosome numbers, sometimes accompanied by photographs, have been

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Table 1. List of previous chromosome counts of *Hypochaeris* from South America (excluding *H. glabra* and *H. radicata*).

Species	2n	n	Reference
<i>H. acaulis</i> (Remy) Britton		4	Wulff (1998)
<i>H. arenaria</i> Gaudich.	8		Moore (1981)
<i>H. brasiliensis</i> (Less.) Griseb. ¹	8		Stebbins et al. (1953); Parker (1971); Ruas et al. (1995)
		4	Coleman (1968); Turner et al. (1979)
<i>H. chillensis</i> (Kunth) Hieron.	8		Tomb et al. (1978); Siljak-Yakovlev et al. (1994); Cerbah et al. (1995); Cerbah et al. (1998a)
		4	Wulff (1992, 1998)
<i>H. chillensis</i> × <i>H. megapotamica</i>		4	Wulff (1992)
<i>H. chillensis</i> × <i>H. microcephala</i> var. <i>albiflora</i>		4	Wulff (1992)
<i>H. chondrilloides</i> (A. Gray) Cabrera		4	Cherubini (1982)
		8	Wulff (1998)
<i>H. elata</i> (Wedd.) Griseb.	8		Krapovickas (1951)
		4	Bernardello (1986)
<i>H. foliosa</i> (Phil.) Reiche	8		Stebbins et al. (1953)
<i>H. gardneri</i> Baker		5	Coleman (1968)
<i>H. glauca</i> (Phil.) Reiche ²	8		Stebbins et al. (1953)
<i>H. halophila</i> (Hauman) Cabrera ²	8		Schnack & Covas (1947)
<i>H. incana</i> (Hook. f. & Arn.) Macloskie		8	Moore (1981)
<i>H. megapotamica</i> Cabrera	8		Saez (1949); Siljak-Yakovlev et al. (1994); Cerbah et al. (1995); Ruas et al. (1995); Cerbah et al. (1998a)
		4	Wulff (1992, 1998)
<i>H. meyeniana</i> (Walp.) Griseb.	8		Diers (1961)
<i>H. microcephala</i> (Sch. Bip.) Cabrera var. <i>albiflora</i> (Kuntze) Cabrera	8		Saez (1949); Siljak-Yakovlev et al. (1994); Cerbah et al. (1995); Ruas et al. (1995); Cerbah et al. (1998a); Wulff (1998)
		4	Wulff (1992)
<i>H. pampasica</i> Cabrera	8		Cerbah et al. (1995); Ruas et al. (1995); Cerbah et al. (1998a)
<i>H. parvifolia</i> H. Kost.	8		Diers (1961)
<i>H. petiolaris</i> (Hook. f. & Arn.) Griseb.		4	Turner et al. (1979)
<i>H. rosenfurtii</i> Cabrera	8		Ruas et al. (1995)
<i>H. sessiliflora</i> Kunth		8	Olsen (1980)
		6	Turner et al. (1967)
		4	Jansen & Stuessy (1980)
<i>H. stenocephala</i> (A. Gray ex Wedd.) Kuntze	16		Stebbins et al. (1953); Diers (1961)
<i>H. taraxacoides</i> (Walp.) Benth. & Hook. f. ³	8		Parker (1971)
<i>H. tweediei</i> (Hook. f. & Arn.) Cabrera ¹	8		Saez (1949)
<i>H. variegata</i> (Lam.) Baker	8		Ruas et al. (1995)

¹⁻³ Treated as synonyms of *H. chillensis*¹, *H. chondrilloides*², and *H. stenocephala*³ by Bortiri (1999).

published for 23 species (e.g., Saez, 1949; Wulff, 1992; Ruas et al., 1995; Cerbah et al., 1998a; Table 1), but detailed karyotypes exist for far fewer taxa (only ca. 6). Most chromosome numbers so far documented are $2n = 8$ with only two cases of uniform tetraploidy known (*H. incana*, Moore, 1981; *H. stenocephala*, Stebbins et al., 1953; Diers, 1961), and two cases of infraspecific tetraploidy (i.e., *H. chondrilloides*, Wulff, 1998; *H. sessiliflora*, Olsen, 1980, both $2n$ and $4n$ reports).

To set the stage for additional evolutionary stud-

ies on *Hypochaeris*, therefore, the purposes of this paper are to: (1) summarize all available previous chromosome counts for South American species of *Hypochaeris*; (2) report original counts for taxa collected in Chile and other Andean regions (Argentina, Bolivia, Ecuador, Peru, and Venezuela); and (3) comment on the chromosomal variation documented within South America, particularly with reference to the already well known cytological picture of European species. Several populations of each taxon have often been analyzed so that infra-

Table 2. New chromosome counts of *Hypochaeris* from South America [all plants from Chile (regions given by Roman numerals) unless indicated otherwise]. Counts are mostly from mitotic preparations; haploid counts (meiosis I and Ist pollen mitosis) are indicated by *; populations for which both diploid and haploid counts were made are marked with **. Abbreviations of collectors: CB = C. Baeza; DC = D. Crawford; JG = J. Grau; PS = P. Stuessy; TS = T. Stuessy; HF = H. Förther; MW = M. Weigend. Vouchers on deposit in WU and CONC (collections by TS and colleagues and López) and M (all other collections). ++ = first report(s) for taxon; + = new chromosomal level.

Taxon, voucher, and chromosome number

H. acaulis (Remy) Britton $2n = 8$

VII. Prov. Talca, Laguna del Maule, Laguna sin Puerto, s.d., *JG Hyp-50*. VIII. Termas de Chillán, Valle de las Nieblas, 15 Jan. 1999, *TS et al. 15565*. IX. 20 km E of Chilean Aduana toward Paso Pino Hachado, 20 Jan. 1999, *TS & CB 15587*. ARGENTINA. 1 km E of Paso Pino Hachado, 20 Jan. 1999, *TS & CB 15593*.

++*H. apargioides* Hook. f. & Am. $2n = 8$

VIII. Parque Nacional Laguna La Laja, 25 Jan. 1998, *TS & DC 15470*; Las Trancas, 30 Jan. 1998, *TS 15481, 15485*, 13 Jan. 1999, *TS et al. 15549**, Valle Hermoso, *15551, 15554*. IX. Reserva Nacional Malalcahuello, 12 Feb. 1998, *TS et al. 15509***, 3 km W of Lonquimay, 13 Feb. 1998, *15513*; 10 km E of Puente Lonquimay, *TS et al. 15515**, 17 km E of Puente Lonquimay, *15516*, 29 km E of Puente Lonquimay, *15517*, 8 km E of Chilean Aduana, 13 Feb. 1998, *15518*; 3 km W of Lonquimay, 19 Jan. 1999, *TS & CB 15576**, 8 km E of Chilean Aduana, 20 Jan. 1999, *15583*, 3 km W of Chilean Aduana, *15594***, 25 km E of Lonquimay, *15595***, 17 Feb. 2000, *15596*, Volcán Llaima, 21 Jan. 1999, *15602**, Volcán Villarrica, Piedra de Aquila, 22 Jan. 1999, *15612**, to Laguna Huinfiucá, 23 Jan. 1999, *15621**, rd to Lonquimay, 16 Feb. 2000, *15809A*.

++*H. clarionoides* (Remy) Reiche $2n = 8$

Región Metropolitana de Santiago, 6 km W of La Parva, 18 Feb. 1998, *TS & PS 15527*, 2 km W of La Parva, *15529**, *15531**.

H. elata (Wedd.) Griseb. $2n = 8$

BOLIVIA. La Paz, Puerto Pérez, Lake Titicaca, s.d., *Karus Hyp-43*.

+*H. meyeniana* (Walp.) Griseb. $2n = 8$

PERU. Dept. Cajamarca, Prov. Contumazá, Bosque de Cachil, s.d., *MW 98/554*.

+*H. meyeniana* (Walp.) Griseb. $+2n = 16$

PERU. Dept. Tacna, Prov. Taranta, S of Volcán Tutupaca, 20 km above Candarave, s.d., *MW & HF 97/688*.

++*H. palustris* (Phil.) De Wild. $2n = 8$

VIII. Valle de Las Nieblas, Termas de Chillan, 15 Jan. 1999, *TS et al. 15566**. IX. 20 km E of Chilean Aduana, 20 Jan. 1999, *TS & CB 15588**, Volcán Villarrica, 22 Jan. 1999, *15606, 15607*, rd to Laguna Huinfiucá, 23 Jan. 1999, *15622*, Volcán Casablanca, 24 Jan. 1999, *15628, 15629*.

H. radicata L. $2n = 8$

VIII. Cerro Ponpón, 21 Jan. 1998, *TS 15450H, 15450J*, Parque Hualpén, Concepción, *15451*; 2 km W of Angol, 24 Jan. 1998, *TS & DC 15454*, 2 km into Parque Nacional Nahuelbuta, *15458**, Parque Nacional Nahuelbuta, *15461*, Piedra de Aguila, *15465, 15466*, 17 km E of Antuco, 25 Jan. 1998, *15468, 15469**, Parque Nacional Laguna La Laja, *15471**, *15473*; Lota, Schwager, 27 Jan. 1998, *TS et al. 15477*, Termas de Chillán, 31 Jan. 1998, *15487*. IX. 12 km E of Curacautín, 12 Feb. 1998, *TS et al. 15506*, 5 km S of Lonquimay, 12 Feb. 1998, *15508*, 8 km E of Chilean Aduana, 13 Feb. 1998, *15519*; 14 km E of Cherquenco, 21 Jan. 1999, *TS & CB 15597**, 1 km W of Pucón toward Volcán Villarrica, 22 Jan. 1999, *15604*, 11 km SE of Aguas Calientes, 24 Jan. 1999, *15626**. Región Metropolitana de Santiago, Santuario de la Naturaleza Yerba Loca, 18 Feb. 1998, *TS & PS 15533*.

++*H. scorzonerae* (DC.) F. Muell. $2n = 8$

Region IV. 5 km E of Huentelauquén, 16 Oct. 1999, *Lopez 503*, 3 km N of Puerto Oscuro, *505*, 6 km N of Puerto Oscuro, *507*.

++*H. scorzonerae* (DC.) F. Muell. $2n = 16$

V. Prov. Quillota, Cerro campana, Mirador de los Guanacos, s.d., *JG 87-29*.

H. sessiliflora Kunth $2n = 8$

ECUADOR. Quito, Paso Guamani, s.d., *JG Hyp-37*; Carchi, Páramo El Ángel, 38, Bolívar, Chimborazo, s.d., *MW Hyp-78, 79*.

++*H. setosa* (Wedd.) Rusby $2n = 8$

VENEZUELA. Mérida, Parque Nacional Sierra Nevada, s.d., *Gaviria 1048*.

Table 2. Continued.

Taxon, voucher, and chromosome number	
++ <i>H. sonchoides</i> Kunth	$2n = 8$ ECUADOR. Pichincha, Nono, NW of Quito, s.d., <i>JG Hyp-36</i> .
++ <i>H. spathulata</i> (Remy) Reiche	$2n = 8$ IX. N of Pucatrihue, 25 Jan. 1999, <i>TS & CB 15633*</i> .
<i>H. stenocephala</i> (A. Gray ex Wedd.) Kuntze	$2n = 16$ PERU. Dept. Puno, Prov. Puno, Ruins of Sillistani, s.d., <i>MW & HF 97/119</i> .
++ <i>H. tenuifolia</i> (Hook. f. & Arn.) Griseb.	$2n = 8$ VII. Prov. Talca, Laguna del Maule, s.d., <i>JG s.n.</i> VIII. Prov. Nuble, Nevados de Chillán, Garganta del Diablo, s.d., <i>JG Hyp-45</i> ; Termas de Chillán, 31 Jan. 1998, <i>TS et al. 15486, 15490A, 1 Feb. 1998, 15492C, 15498, 15505</i> . IX. Volcán Lonquimay, 19 Jan. 1999, <i>TS & CB 15577-3*</i> ; Volcán Llaima, 21 Jan. 1999, <i>15600</i> , Volcán Villarrica, 22 Jan. 1999, <i>15605</i> .
++ <i>H. tenuifolia</i> (Hook. f. & Arn.) Griseb.	$2n = 16$ VIII. Termas de Chillán, 31 Jan. 1998, <i>TS et al. 15489</i> . IX. 5 km into Reserva Nacional Malalcahuello, 12 Feb. 1998, <i>TS et al. 15510</i> .
++ <i>H. thrincioides</i> (Remy) Reiche	$2n = 8$ VIII. Cerro Ponpón near Concepción, 21 Jan. 1998, <i>TS 154501</i> . IX. 10 km W into Parque Nahuelbuta, 24 Jan. 1998, <i>TS & DC 15456**</i> .

specific euploidy or dysploidy might be revealed and better interpreted.

It must also be stressed that the present taxonomy and nomenclature of *Hypochaeris* in South America needs comprehensive revision. Despite the very helpful treatments on Argentinean species by Cabrera (1971, 1974, 1976, 1978) and more recently Bortiri (1999), there still remains confusion in proper limits and correct names for many taxa. Future studies will have to resolve these important issues.

MATERIALS AND METHODS

MATERIALS

Bud and seed materials of *Hypochaeris* were collected in South America (Table 2). Collections were of populational samples in all instances. Vouchers are on deposit at CONC, M, and WU.

METHODS

For mitotic chromosome counts, root meristems were obtained from surface-sterilized seeds germinated for two days on wet filter paper or from mature plants in cultivation at M.

Root tips were pretreated with 0.1% colchicine for 2 hrs at room temperature in darkness, fixed in 3:1 (ethanol:acetic acid) for 24 hr., and stored until use at -20°C . For meiotic chromosome counts flower buds were fixed in modified Carnoy's solution (4:3:1; chloroform:absolute ethanol:glacial acetic

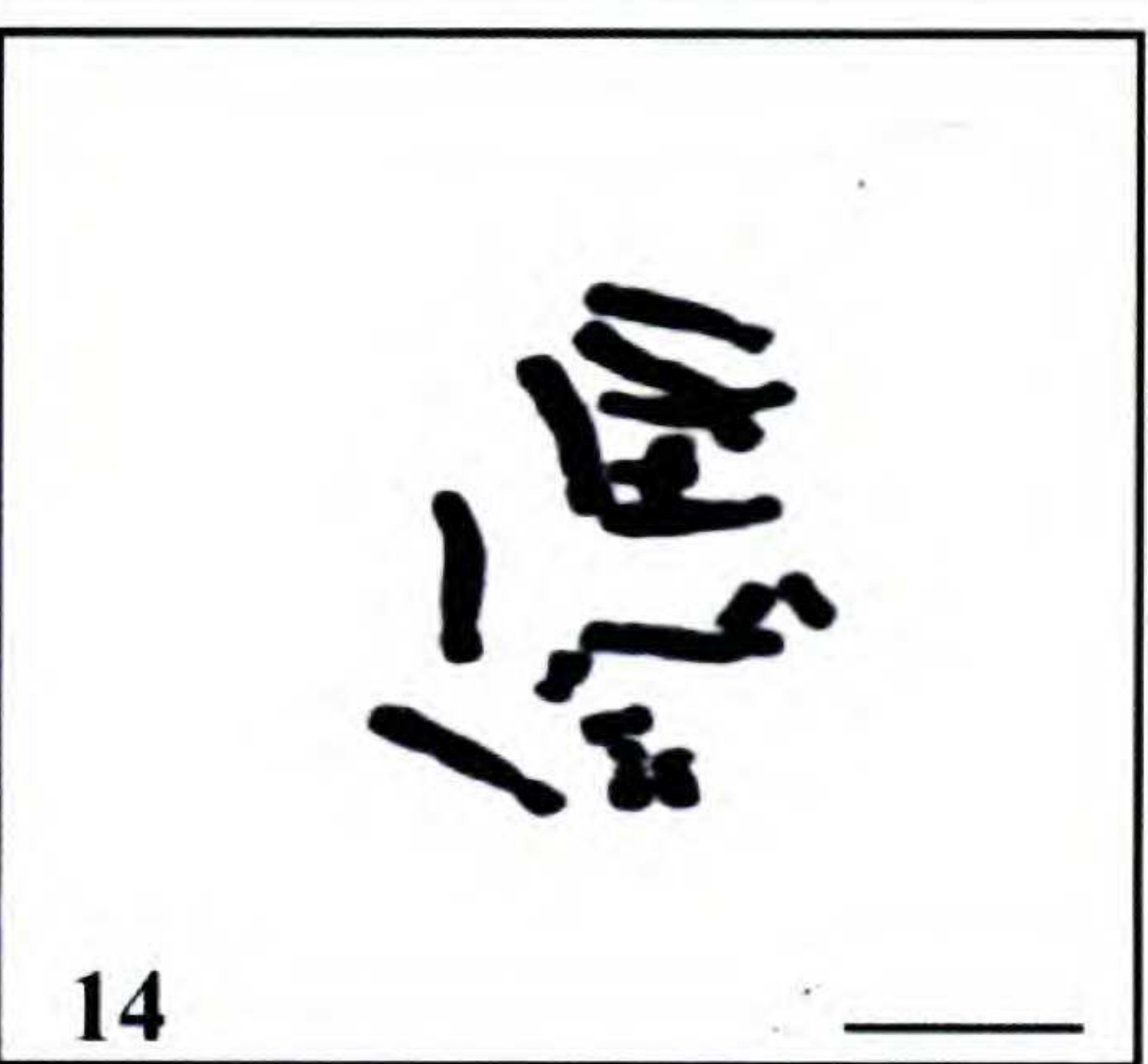
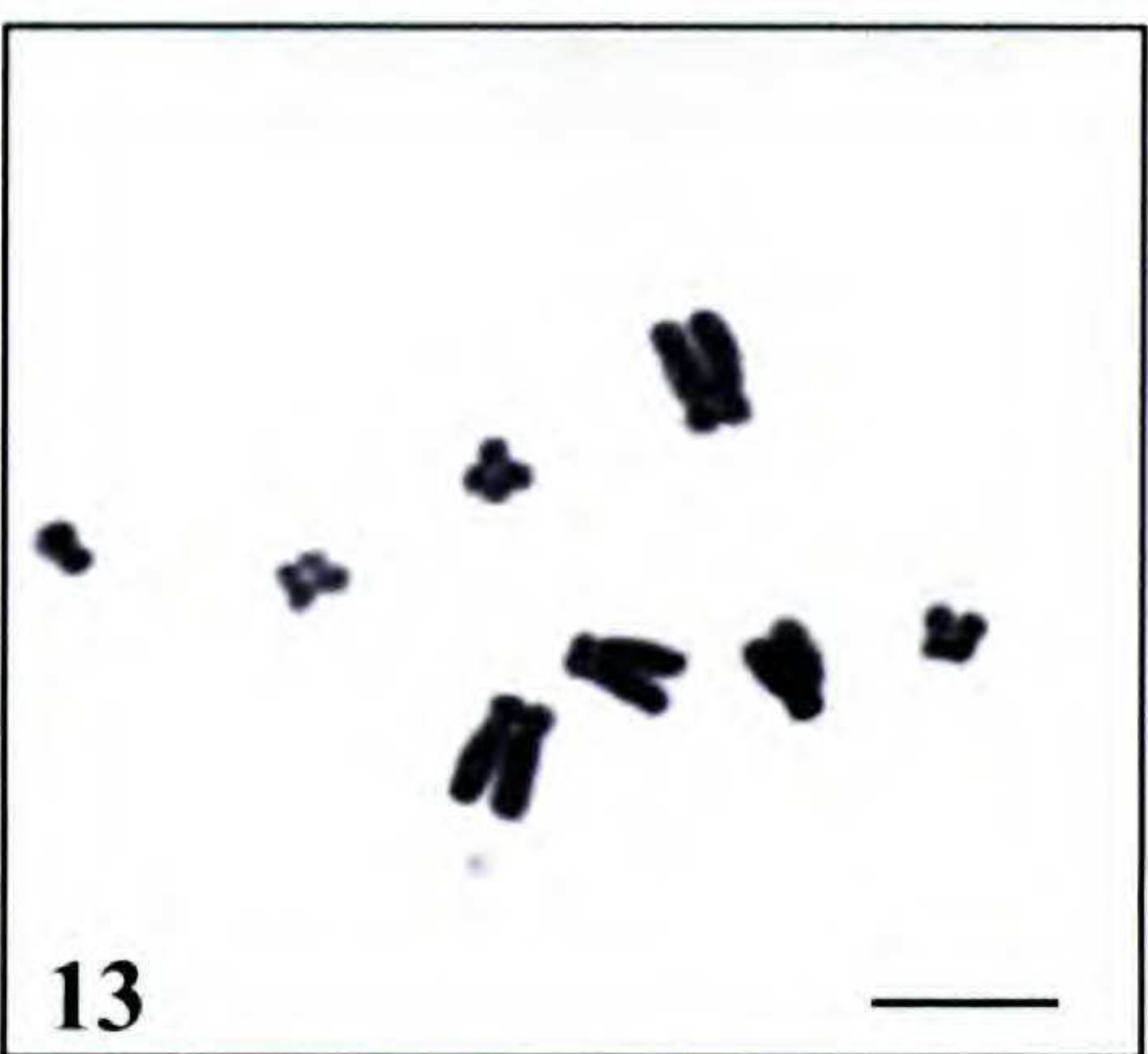
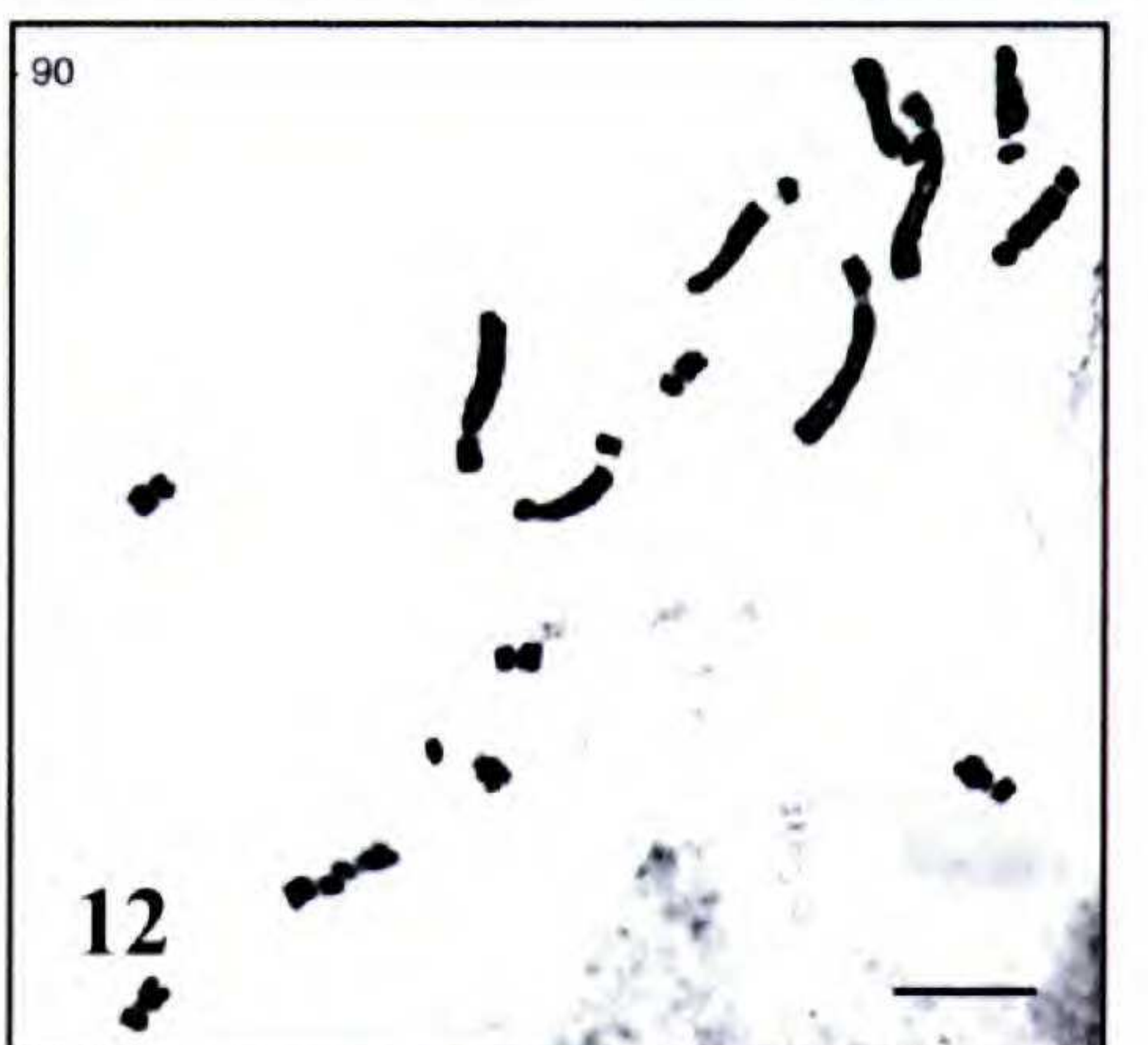
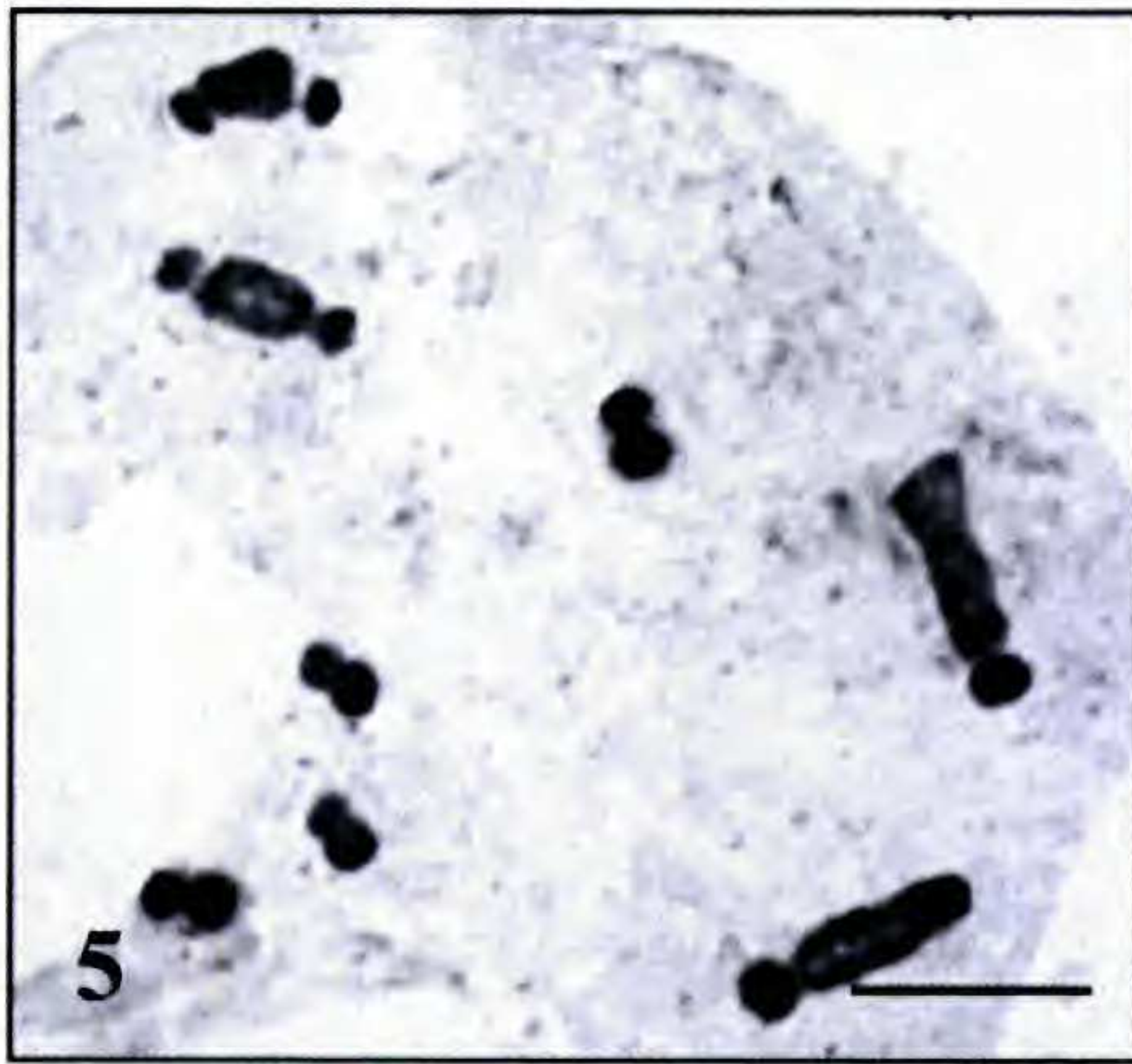
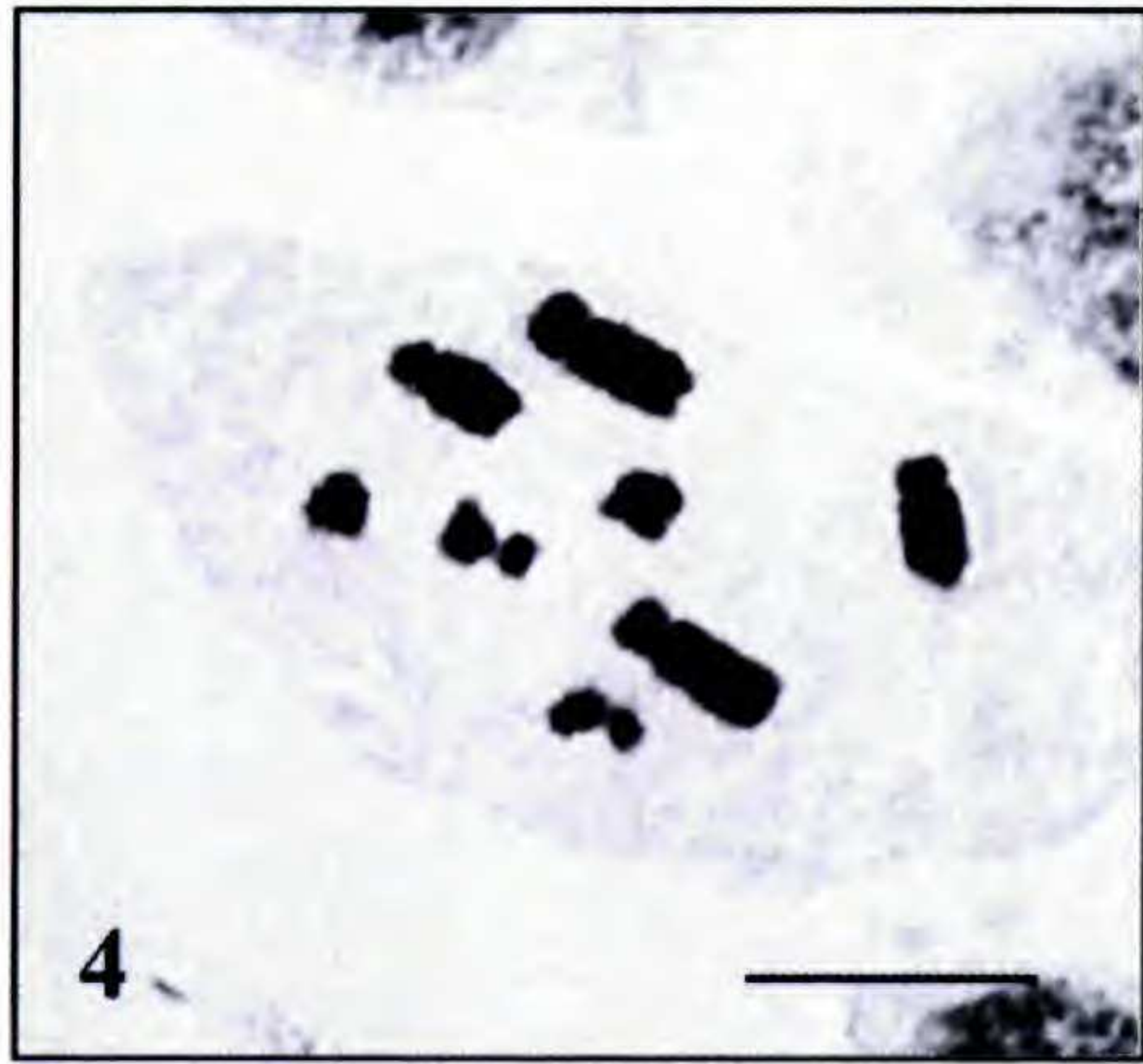
acid), transferred to 70% ethanol, and stored at 4°C until examination in the laboratory.

Chromosome preparations were made using Feulgen staining with Schiff's reagent following standard methods (Fukui & Nakayama, 1996). Root tips and flower buds were washed in distilled water to remove the fixative, hydrolyzed in 5N HCl for 30 min at 20°C , and washed and stained with Schiff's reagent in darkness for 1–2 hr. Squash preparations were made in a drop of 45% acetic acid. After coverslip removal on dry ice, preparations were dried for 24 hr. at 37°C and mounted in DPX. Chromosome numbers were determined from at least 20 cells of at least two florets for meiotic counts and of at least three seedlings for mitotic observations.

RESULTS AND DISCUSSION

Eighty-nine new chromosome counts are reported from 85 populations of 15 species of *Hypochaeris* from South America (Table 2) including first reports for nine taxa: *H. apargioides*, *H. clarionoides*, *H. palustris*, *H. scorzonerae*, *H. setosa*, *H. sonchoides*, *H. spathulata*, *H. tenuifolia*, and *H. thrincioides*. All counts give $2n = 8$, with infraspecific tetraploidy ($2n = 4x = 16$) also documented in *H. scorzonerae* and *H. tenuifolia*. A new tetraploid population has also been detected in *H. meyeniana*.

These new data, in correlation with previously published reports for *Hypochaeris* in South America (Table 1), yield 32 species (of ca. 50) now counted from 138 populations. A brief combined analysis



shows 25 uniformly diploid ($2n = 8$) species, two species uniformly tetraploid ($2n = 16$; *H. incana* and *H. stenocephala*), and five species with both diploid and tetraploid cytotypes (*H. chondrilloides*, *H. meyeniana*, *H. scorzonerae*, *H. sessiliflora*, and *H. tenuifolia*). One species, *H. gardneri*, has been reported previously as $n = 5$ (Coleman, 1968), and another, *H. sessiliflora*, has been documented as $n = 6$ (Turner et al., 1967).

Because of the strong uniformity in chromosome levels among South American species of *Hypochaeris* (all $n = 4$ or $n = 8$), further comments on these two deviating reports are in order. The $n = 6$ report (Turner et al., 1967) for *H. sessiliflora* contrasts with more typical $n = 4$ (Jansen & Stuessy, 1980) or $n = 8$ (Olsen, 1980). Examination of the voucher of *H. sessiliflora* reported by Turner et al. (1967; *Wurdack* 437, TEX) with camera lucida drawing of meiotic bivalents attached, suggests that $n = 4$ is probable, with some homologous chromosomes being pulled apart in metaphase I/early anaphase I earlier than the others. Turner, in fact, wrote in 1977 (handwritten note on the voucher): "In hindsight and with more thought this could be $n = 4$!" The voucher for the count of $n = 5$ for *H. gardneri* has not yet been located despite an herbarium search. It is worth mentioning that the European *H. glabra* with $n = 5$ is also known to be adventive in South America (e.g., Matthei, 1995; Bortiri, 1999). Because of the morphological variability of taxa of *Hypochaeris*, and hence difficulties with identification, an examination of the voucher for *H. gardneri* will be essential to reveal whether this represents a new aneuploid level in native species of the continent.

Karyotypes of all newly analyzed South American species of *Hypochaeris* are bimodal and asymmetric and similar in overall morphology to karyotypes of species analyzed previously (Figs. 1–15; see also references in Table 1). In general, they consist of two large and two small chromosome pairs. Two of these pairs, one large subtelocentric and one smaller acrocentric, appear to bear satellites. The other two pairs are most often acrocentric. Despite this general uniformity of karyotype and a reasonably stable chromosome number ($2n = 8$), consistent karyological differences among taxa do

exist. The main differentiation of karyotype concerns chromosome size changes and the presence of satellites (Figs. 1–6, 8–15). A detailed analysis of karyotypes of South American *Hypochaeris* and their evolutionary importance will be reported elsewhere.

Although the emphasis in this paper is on new cytological reports of native South American species of *Hypochaeris*, additional reports for the introduced *H. radicata* are also included. This taxon is abundant in Chile (Matthei, 1995; pers. obs.), growing from sea level to over 2000 m and often found intermixed with native species. Because of the possibility of hybridization between *H. radicata* and native congeners, which could confuse interpretations of patterns and processes of evolution, sampling of this taxon was also included (Table 2). Results show the typical chromosome level ($2n = 8$; Fig. 7) for this species and symmetric karyotype and no irregularities, effectively excluding hybridization. Judging by chromosome number, the other weedy species of the genus, *H. glabra*, (distinctive with $2n = 10$, Stebbins et al., 1953), is much less common in South America, at least within Chile, and no representatives of this species have been examined cytologically during this study.

Tetraploidy ($2n = 4x = 16$) has been previously reported for four South American *Hypochaeris* species: *H. chondrilloides* (Wulff, 1998), *H. incana* (Moore, 1981), *H. sessiliflora* (Olsen, 1980), and *H. stenocephala* (Stebbins et al., 1953; Diers, 1961). For *H. chondrilloides* and *H. sessiliflora*, both ploidy levels ($2x$ and $4x$) were reported. The present paper adds three more species, *H. meyeniana* (Fig. 5), *H. scorzonerae*, and *H. tenuifolia* (Figs. 13, 14), in which infraspecific polyploid cytotypes are known. Karyological data provide some suggestions on the mode of origin of these tetraploid cytotypes. The $4x$ races in *H. tenuifolia* and *H. stenocephala* possess karyotypes consisting of four equal-sized sets of chromosomes. It is probable, therefore, that these polyploids are of autopolyploid origin. We suspect this to be the case also in *H. sessiliflora* (Fig. 8) and perhaps also for *H. chondrilloides* that contain both $2x$ and $4x$ cytotypes, although no detailed karyotypes are available for the latter. Understanding the origin of the apparently uniformly tetraploid

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Figures 1–15. Mitotic chromosomes of South American species of *Hypochaeris*. Scale bar = 5 μ m. —1. *H. acaulis*, TS et al. 15565.—2. *H. apargioides*, TS 15485.—3. *H. clarionoides*, TS & PS 15527.—4. *H. elata*, RK Hyp-43.—5. *H. meyeniana*, MW 98/554.—6. *H. palustris*, TS et al. 15566.—7. *H. radicata*, TS & PS 15533.—8. *H. sessiliflora*, JG Hyp-38.—9. *H. setosa*, JGa 1048.—10. *H. sonchoides*, JG Hyp-36.—11. *H. spathulata*, TS & CB 15633.—12. *H. stenocephala*, MW & HF 97/119.—13. *H. tenuifolia*, TS & CB 15605.—14. *H. tenuifolia*, TS et al. 15510.—15. *H. thrincioides*, TS 15450I.

Hypochoeris stenocephala and possibly *H. incana* (only one count known) will be important for documenting evolutionary mechanisms in the group.

Because of the close morphological and karyological similarity and evolutionary relatedness of South American species of *Hypochoeris*, special attention was given to searching for meiotic irregularities that might signal hybridization. Meiotic counts showed exclusively four regular bivalents in all examined populations. Previous reports on meiotic chromosome numbers have shown similar results (Wulff, 1992, 1998). Only experimentally obtained hybrids between *H. chillensis* and *H. megapotamica* showed some irregularities in homologous chromosome pairing with 4II and occasionally 3II + 2I (Wulff, 1992). Presumptive natural hybrids of *H. chillensis* and *H. microcephala* var. *albiflora*, however, showed regular bivalent formation suggesting the possibility of recent origin of these species and high degree of karyotype similarity (Wulff, 1992). Two instances in our own field collections suggested possible hybridization based upon morphological features: *H. apargioides* × *H. tenuifolia* (TS et al. 15554) and *H. palustris* × *H. tenuifolia* (TS & CB 15607). Because some differences in chromosome size and presence of satellites are obvious in the case of *H. apargioides* (Fig. 2) and *H. tenuifolia* (Fig. 13), hybrid individuals between these taxa should be detectable. These potential hybrids were found to be diploid, however, with no differences in size of chromosomes of the two haploid sets. Based on karyomorphology, possible hybrid origin of these populations is unsupported.

In contrast to broad cytological diversity among nine European species of *Hypochoeris* ($2n = 6, 8, 10, 12$; Mugnier & Siljak-Yakovlev, 1987; Cerbah et al., 1998a), cytological uniformity of the New World members of the genus suggests several aspects regarding evolution of the group. First, because the karyotype of South American taxa represents only one general pattern, in contrast to several found among European species, it can be hypothesized that the former evolved from out of the latter. This hypothesis is also corroborated by recent molecular phylogenetic studies of nuclear (ITS; Cerbah et al., 1998b; R. Samuel et al., in prep.) and chloroplast (*trnL*; R. Samuel et al., in prep.) genes. Second, the abundance of South American taxa representing so many different growth forms and occurring in so many diverse habitats is strongly indicative of rapid and recent adaptive radiation. Third, the mechanisms of speciation accompanying this explosive evolution have clearly not been driven by gross macro-cytological alter-

ations, such as dysploidy, euploidy, and marked karyotypic change. *Hypochoeris* represents a genus, therefore, in which perhaps more minor amounts of karyotypic, and certainly genetic, change has accompanied speciation. Because of this situation and due to the large and few chromosomes, the genus in South America provides an excellent opportunity to map the genome and determine minor karyotypic changes during speciation, within context of the relatively stable $2n = 8$ karyotype, as has been done successfully for *Helianthus* in North America (Rieseberg et al., 1995; Rieseberg, 2001).

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